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IS THERE A CAUSAL RELATIONSHIP BETWEEN FINANCIAL PERFORMANCE AND PREMIUM PRODUCTION? EVIDENCE FROM TURKISH INSURANCE INDUSTRY

FİNANSAL PERFORMANS İLE PRİM ÜRETİMİ ARASINDA BİR NEDENSELLİK İLİŞKİSİ VAR MI? TÜRK SİGORTA SEKTÖRÜNDEN KANITLAR

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Abstract

This study aims at determining the causal link between financial performance and premium production of non-life insurance companies. The relation between the financial performance and premium production is explored employing data from the 2011-2019 period for eight Turkish non-life insurance companies. In the first stage of the analysis, a hybrid model including LOPCOW, SWARA II, and MARCOS methods is proposed to determine companies' financial performance values. In this stage, a novel integrated weighting method for calculating criterion weights is applied based on objective information and judgements of decision-makers. In the second stage, the association between financial performance and premium production is investigated by correlation analysis. In the last stage, the causality linkage between the two variables is estimated using a panel causality test developed by Dumitrescu and Hurlin (2012). According to the results obtained from the panel causality test, the bidirectional causality relation exists between financial performance and premium production. Besides, the individual panel causality results reveal that bidirectional causality is valid for only Allianz and Anadolu insurance companies, which had an average share of over 35% in total non-life premium production during the analysis period. The paper provides fresh evidence on the association between the financial performance and premium production, particularly from the Turkish context.

Keywords: Insurance, Financial Performance, Premium Production, LOPCOW, SWARA II, MARCOS, Panel Causality.

Öz

Bu çalışma, hayat dışı sigorta şirketlerinin finansal performansı ile prim üretimi arasındaki nedensellik ilişkisini belirlemeyi amaçlamaktadır. Finansal performans ile prim üretimi arasındaki ilişki, sekiz Türk hayat dışı sigorta şirketi için 2011-2019 dönemi verileri kullanılarak incelenmiştir. Analizin ilk aşamasında şirketlerin finansal performans değerlerinin belirlenmesi için LOPCOW, SWARA II ve MARCOS yöntemlerini içeren hibrit bir model önerilmiştir. Bu aşamada, objektif bilgilere ve uzman komitesinin sübjektif yorumlarına dayalı olarak kriter ağırlıklarını hesaplamak için yeni bir entegre ağırlıklandırma yöntemi uygulanmıştır. İkinci aşamada ise finansal performans ile prim üretimi arasındaki ilişki korelasyon analizi ile araştırılmıştır. Son aşamada, iki değişken arasındaki nedensellik ilişkisi, Dumitrescu ve Hurlin (2012) tarafından geliştirilen bir panel nedensellik testi kullanılarak tahmin edilmiştir. Panel nedensellik testinden elde edilen sonuçlara göre finansal performans ile prim üretimi arasında çift yönlü nedensellik ilişkisi bulunmaktadır. Ayrıca, bireysel panel nedensellik sonuçları, analiz döneminde toplam hayat dışı prim üretiminde ortalama %35'in üzerinde paya sahip olan Allianz ve Anadolu sigorta şirketleri için çift yönlü nedenselliğin geçerli olduğunu ortaya koymaktadır. Bu makale özellikle Türkiye bağlamında finansal performans ile prim üretimi arasındaki ilişkiye dair yeni kanıtlar sunmaktadır.

Anahtar Kelimeler: Sigorta, Finansal Performans, Prim Üretimi, LOPCOW, SWARA II, MARCOS, Panel Nedensellik.

GENİŞLETİLMİŞ ÖZET

Çalışmanın Amacı

Bu çalışmanın amacı hayat dışı sigorta şirketlerinin finansal performansı ile prim üretimi arasındaki nedensellik ilişkisini araştırmaktır. Bu amaçla çalışmada 2011-2019 döneminde Türk sigortacılık sektöründe faaliyette bulunan ve prim üretimi açısından ilk ona giren sekiz hayat dışı sigorta şirketinin örneklemi inceleme altına alınmıştır.

Araştırma Soruları

Prim üretimi, sigorta hizmetlerinden yararlanan ekonomik birimlerin ödediği bedeli ifade eder ve sigorta şirketlerinin gelirlerinin temel belirleyicisidir. Aynı zamanda tüm sigorta sektörü paydaşlarına başarısı ve finansal performansı hakkında önemli bilgiler sağlayan temel bir göstergedir. Bunun yanı sıra sigortacılık sektöründe üretilen primlerin toplumsal hayata, para ve sermaye piyasalarının gelişimine sağladığı katkı, sektördeki en temel göstergelerden biri olmasını sağlamaktadır. Bu nedenle, Türk sigortacılık sektöründe baskın bir yere sahip olan hayat dışı sigorta şirketlerinin finansal performansı ile prim üretimi arasındaki bağlantının belirlenmesi birçok araştırmacı ve düzenleyici ve denetleyici birimler için önemli bir araştırma konusudur.

Literatür Araştırması

Literatürde hayat ve hayat dışı sigorta şirketleri için finansal performans ile prim üretimi arasındaki ilişkiyi inceleyen sınırlı sayıda çalışma bulunmaktadır. Bu çalışmalar daha çok prim üretiminin finansal performans üzerindeki etkisinin araştırılmasına odaklanmıştır. Ancak, bu ilişki üzerine ampirik çalışmalar kesin olmayan sonuçlar vermektedir. Örneğin, bazı araştırmalar prim üretimi ile finansal performans arasında pozitif ve istatistiksel olarak anlamlı bir ilişki rapor etmiştir (Shiu, 2004; Oscar Akotey vd., 2013; Öner Kaya, 2015; Pjanić vd., 2018; Camino-Mogro ve Bermúdez-Barrezueta, 2019). Ancak, bazı araştırmacılar ise prim üretimi ile finansal performans arasında negatif ve istatistiksel olarak anlamlı bir ilişki olduğunu bulmuşlardır (Pervan vd., 2012; Burca ve Batrinca, 2014; Eling ve Jia, 2019). Dahası, üçüncü gruptaki araştırmacılar ise prim üretimi ile finansal performansın istatistiksel olarak ilişkili olmadığı sonucuna varmışlardır (Wang vd., 2007; Ahmed vd., 2011; Zainudin vd., 2018; Killins, 2020; Banerjee ve Savitha, 2021).

Yöntem

Üç aşamalı analizin ilk aşamasında hayat dışı sigorta şirketlerinin finansal performans değerlerinin belirlenmesi için LOPCOW, SWARA II ve MARCOS yöntemlerini içeren yeni hibrit bir model önerilmiştir. Bu aşamada, objektif bilgilere ve uzman komitesinin sübjektif yorumlarına dayalı olarak kriter ağırlık katsayılarını hesaplamak için için LOPCOW-SWARA karar modelinden oluşan yeni bir entegre ağırlıklandırma yöntemi uygulanmıştır. İkinci aşamada ise finansal performans ile prim üretimi arasındaki ilişki korelasyon analizi ile araştırılmıştır. Son aşamada, söz konusu iki değişken arasındaki nedensellik ilişkisi Dumitrescu ve Hurlin (2012) tarafından geliştirilen panel nedensellik testi kullanılarak tahmin edilmiştir.

Sonuç ve Değerlendirme

LOPCOW-SWARA II ağırlıklandırma modelinden elde edilen sonuçlara göre hayat dışı sigorta sektöründe performans üzerinde en etkili üç performans göstergesi sırasıyla teknik denge, özsermaye ve faaliyet giderleridir. MARCOS sıralama sonuçları dikkate alındığında ilk üç yılda Axa şirketi, 2018 yılı haricinde diğer 5 yılda ise Allianz şirketi seçilen göstergeler açısından en iyi performansı sergileyen sigorta şirketleridir. Çalışmada 2011-2019 dönemi için hesaplanan finansal performans değişkeni ile prim üretimi değişkeni arasında bir ilişki olup olmadığı korelasyon analizi ile araştırılmıştır. Spearman korelasyon analizi sonuçları iki değişken arasında pozitif yönde ve anlamlı bir ilişki olduğunu ortaya koymakatadır. Daha sonra gerçekleştirilen Dumitrescu-Hurlin'in panel nedensellik analizi sonucunda finansal performans ile prim üretimi arasında iki yönlü nedensellik olduğu tespit edilmiştir. Sonuçlar düzenleyici otoritelere ve politika yapıcılara sektörün istikrarının tesis edilmesinde ve sürdürülebilir ekonomik büyümenin sağlanmasında faydalı olabilir. Türkiye sigorta piyasasının dinamik bir yapıya sahip olduğu düşünüldüğünde, bu sektöre yatırım yapmak isteyen yabancı yatırımcılar için de sonuçlarımız önem arz etmektedir. Son olarak, çalışmanın sonuçları, sektördeki yöneticilerin daha doğru ve güvenilir bilgilerle daha sağlıklı kararlar almalarına yardımcı olabilir, bu da şirketle ilgili tüm çıkar gruplarının uygun ekonomik kararlar almasını kolaylaştırabilir.

1. INTRODUCTION

In daily life, individuals and companies that are a part of economic life are faced with many uncertainties and risks. Every risk can lead to larger costs in terms of economic units (Chen and Lu, 2015). Therefore, economic units must take measures against possible risks. At this point, insurance protects economic units against potential risks and contributes to economic units to minimize these risks. The insurance industry also has a key role in enhancing social peace and welfare (Hasan et al., 2018; Camino-Mogro and Bermúdez-Barrezueta, 2019; Ecer and Pamucar, 2021).

In addition, insurance activities have an important place in a country's economic development and growth. The insurance sector, one of the most important components of the financial system, has the ability to create resources for the national economy thanks to the funds collected from the policyholders. Directing these funds to investments in the country contributes to the increase in the level of production and employment, which also helps to surge the gross domestic product (Sharma et al., 2021).

Insurance companies are one of the most basic actors of the insurance sector, which has a vital position in a country both socially and economically (Ward and Zurbruegg, 2000). Therefore, the level of success achieved by insurance companies based on their performance is of great importance for all units in a country's economy.

Analyzing the insurance companies’ financial performance can help these companies identify the key criteria for sustainable financial success and enable them to healthfully assess their position in the sector in terms of premium production (Almajali et al.,2012).

Premium production refers to the price paid by economic units benefiting from insurance services and is the main determinant of insurance companies’ income. It is also a basic indicator that provides important information to all insurance industry stakeholders about its success and financial performance. Besides, the contribution of the premiums produced in the insurance sector to social life and the development of money and capital markets makes it one of the most fundamental indicators in the sector (Apergis and Poufinas, 2020).

Identifying the linkage between financial performance and premium production is an important research topic for many researchers and practitioners. There are limited studies in the literature that examine the link between financial performance and premium production for life and non-life insurance companies. These studies have mostly focused on investigating the impact of premium production on financial performance. However, empirical studies on this association provide inconclusive results. For instance, some studies have found a statistically significant positive association between premium production and financial performance (Shiu, 2004; Oscar Akotey et al., 2013; Öner Kaya, 2015; Pjanić et al., 2018; Camino-Mogro and Bermúdez-Barrezueta, 2019). Others have reported that premium production has a statistically significant negative impact on financial performance (Pervan et al., 2012; Burca and Batrinca, 2014; Eling and Jia, 2019). Whereas, others have documented that the premium production and the financial performance are statistically unrelated (Wang et al., 2007; Ahmed et al., 2011; Zainudin et al., 2018; Killins, 2020; Banerjee and Savitha, 2021).

Our research questions regarding the association between financial performance and premium production are as follows.

1. Is there any significant relationship between financial performance and premium production?

2. If there is a significant relationship between the two variables, what is the direction of this relationship?

This study aims at determining the causal link between financial performance and premium production of non-life insurance companies operating in Turkey. This paper contributes to the existing literature in the following aspects. Firstly, most of the earlier studies in the literature focus on a single source of data based on financial ratios such as return on assets or return on equity to measure companies' financial performance. However, using only a single data source to evaluate companies' performance can lead to a one-sided evaluation rather than an objective assessment. Therefore, in this study, a multidimensional data set is employed to measure companies' financial performance. Secondly, unlike previous studies, we employ a novel hybrid approach that includes the LOgarithmic Percentage Change-driven Objective Weighting (LOPCOW), the Stepwise Weighted Assessment Ratio Analysis II (SWARA II) and the Measurement of alternatives and ranking according to COmpromise solution (MARCOS) in the financial performance measurement of companies. Thirdly, to explore the direction of causality between financial performance and premium production, we employ Dumitrescu and Hurlin (2012) panel causality test that produces reliable and stable results on small and large heterogeneous panels and is robust to cross-section dependence problem. Fourthly, this study is one of the innovative and pioneering studies combining MCDM techniques with panel data econometrics. Lastly, firms' top management, board of directors, and policymakers can employ the introduced decision-making approach as an assistive tool for a detailed assessment of firms' sustainability performance in a dynamic environment.

The main reasons for using objective (LOPCOW) and subjective (SWARA II) criterion weights together in this study can be summarized as follows: (i) it allows both the objective information in the data and the subjective information based on the experts' knowledge and experience to be evaluated together. Thus, more reasonable weights for performance criteria can be calculated; (ii) it offers the opportunity to include many variables in the assessment process with less computation; (iii) it can be easily implemented by decision-makers without requiring the use of programs or software; (iv) it is useful and dynamic because it contains objectivity and subjectivity; and (v) the fact that LOPCOW takes into account negative values in the data reveals its superiority over other objective methods (Ecer and

Pamucar, 2022). In addition, the superiority of SWARA II compared to other subjective weighting methods can be explained with few comparisons and simplicity (Keshavarz-Ghorabaee, 2021). The advantages of employing the algorithm of the MARCOS approach are as follows: (i) even though it is a relatively new approach, it is a practical, flexible, effective and powerful method.; (ii) it enables compromise ranking in terms of ideal and anti-ideal solutions; and (iii) it does not require exhausting computations (Stević et al., 2020). Consequently, the suggested model (i.e., LOPCOW-SAWA-II-MARCOS) provides a robust analytical framework for multi-perspective and multi-period assessments of the performance depending on selected decision criteria.

The rest of our paper is divided as follows. Section 2 presents a brief summary of the literature. Section 3 expresses the methodology of the study. Section 4 presents the implementation and discusses the empirical results. This section also presents sensitivity analysis. While Section 5 presents discussion and managerial implements and Section 6 offers some conclusions.

2. LITERATURE REVIEW

In previous studies focusing on both life and non-life insurance companies, the determinants of the financial performance of the companies or the factors affecting the financial performance were examined with static and dynamic panel data analysis techniques. In most of these studies, it has been reported that the relationship between the premium production variable, which is the key variable for the insurance industry, and financial performance is positive, negative or insignificant. A brief summary of some of these studies is presented in Table 1.

Table 1. Past Studies in the Literature

Author(s)	**Sample**	**Period**	**Method(s)**	**Result**
Shiu (2004)	The UK general insurance market	1986-1999	OLS, fixed and random effects panel data estimators	There exists a positive association between financial performance (FP) and premium production (PP).
Wang et al. (2007)	35 insurance providers from Taiwan	2000-2002	DEA and regression analyses	No significant linkage is reported between FP and PP.
Pervan et al. (2012)	all non-life and composite insurance companies in the Bosnia and Herzegovina	2005-2010	Dynamic panel regression analysis	A negative sign is reported for PP variable.
Burca and Batrinca (2014)	21 insurance companies from Romainia	2008-2012	Fixed and Random effects panel estimators	A negative sign for PP is observed. This means that there is an inverse relationship between the two variables.
Oscar Akotey et al. (2013)	10 life insurers in Ghana	2000-2010	Panel data regression	PP has a positive relation with insurers' FP.

Öner Kaya (2015)	24 non-life insurers from Turkey	2006-2013	OLS, fixed and random effects panel data estimators	The relationship between PP and FP is positive.
Pjanić et al. (2018)	Serbian non-life insurers	2010-2015	Multi-linear regression model	There is a positive linkage between FP and PP.
Camino-Mogro and Bermúdez-Barrezueta (2019)	Life and non-life insurers from the Ecuadorian insurance industry	2001-2017	POLS, Fixed effects, Panel corrected standard errors and Feasible generalized least square estimators	The PP has a positive relationship with FP both in life and non-life insurance markets.
Berteji and Hammami (2016)	8 life insurance companies in Tunisia	2005-2014	Panel data regression analysis	A significant positive link is found between FP and PP.
Mazviona et al. (2017)	20 insurance companies from Zimbabwe	2010-2014	Factor analysis and linear regression analysis	A significant relationship is not found between FP and PP.
Killins (2020)	Canadian life insurance companies	1996-2018	fixed and dynamic panel models	It has been reported that there is no statistically significant relationship between FP and PP.
Banerjee and Savitha (2021)	14 life insurers from India	2009–2019	Fixed and random effects estimators	There exists no statistically significant correlation between FP and PP.
Muthulakshmi and Muthumoni (2023)	4 public sectors non-life insurers	2009-2021	OLS regression analysis	A positive and significant association was reported between FP and PP.
Al-Faryan and Alokla (2023)	35 insurance firms from Saudi Arabia	2008-2014	Panel data analysis and probit model	There was no association between FP and PP.
Msomi (2023)	121 non-life insurers from 48 African countries	2008–2019	POLS and two step System GMM	The PP is the statistically significant determinant of FP.

As can be seen in Table 1, the relationship between financial performance and premium production has been empirically examined in different countries, branches, periods and using alternative methods. However, there is no consensus on the relationship between these two variables in these studies. Therefore, this study aims to fill the existing gap in the literature by examining the link between the two variables, using both MCDM and panel data regression technique.

3. METHODOLOGY

In this section, calculation steps of multi-criteria decision-making tools employed in measuring financial performance, correlation analysis, and panel causality test are explained.

3.1. The Calculation Procedure of LOPCOW method

Developed by Ecer and Pamucar (2022), LOPCOW is one of the newest objective criterion weighting techniques procedures. The steps of LOPCOW is delineated as follows:

Step 1: A decision matrix (X) having *m* alternative and *n* criteria is constructed.

$$X = \begin{bmatrix} x_{11} & \cdots & x_{1j} & \cdots & x_{1n} \\ \vdots & \vdots & \vdots & \ddots & \ddots \\ x_{m1} & \cdots & x_{mj} & \cdots & x_{mn} \end{bmatrix} \quad (1)$$

Step 2: X matrix is normalized utilizing the linear max-min normalization technique to obtain the elements of the normalized matrix (R).

$$r_{ij} = \frac{x_{max} - x_{ij}}{x_{max} - x_{min}}, \text{if } j \text{ is a non} - \text{beneficial criteria} \quad (2)$$

$$r_{ij} = \frac{x_{ij} - x_{min}}{x_{max} - x_{min}}, \text{if } j \text{ is a beneficial criterion} \quad (3)$$

Step 3: Computation of the percentage values (PVs) of each criterion. Eq. (4) is utilized to obtain for the PVs.

$$PV_{ij} = \left| \ln \left(\frac{\sqrt{\frac{\sum_{i=1}^{m} r_{ij}^2}{m}}}{\sigma} \right) \right| .100 \quad (4)$$

In Eq. (4), σ is standard deviation and m is the number of alternatives.

Step 4: Calculation of weighting coefficients for each criterion.

$$w_j^o = \frac{PV_{ij}}{\sum_{i=1}^{n} PV_{ij}} \quad (5)$$

3.2. The Calculation Procedure of SWARA II Method

The SWARA II method is proposed by Keshavarz-Ghorabaee (2021) for the subjective determination of weighting techniques. SWARA II, which is a modified version of the SWARA method, uses the following steps to determine subjective weights:

Step 1: Sort the criteria in descending order of importance, i.e., first criterion in the sorted list has the highest importance. The position or order of the *j*th criteria in the list is denoted by asp_j (*j*=1, 2,…,n).

Step 2: The preference of each criterion over the next criterion in the sorted list is identified by the expert committee employing the linguistic terms indicated in Table 2. The preference value of the [p_j] th criterion is represented by $h_{[pj]}$.

Table 2. Linguistic Variables and Their Corresponding Values

Linguistic Variable	Value
VVL (very very low)	1
VL (very low)	2
L (low)	3
ML (medium– low)	4
M (medium)	5
MH (medium– high)	6
H (high)	7
VH (very high)	8
VVH (very very high)	9

Step 3: Identify the preference degree (PD) for each criterion.

$$PD_{[pj]} = u\left(h_{[pj]}\right) = (\frac{h_{[pj]}}{10})^2 \quad (6)$$

Where $0 \leq$ PD[pj] ≤ 1 and u is a utility function and can be customized based on the characteristics of the problem and opinions of the experts. The nonlinear utility function proposed by Keshavarz-Ghorabaee (2021) is adopted in this study.

Step 4: Calculate the relative weight coefficient. The calculation is carried out from the *n*th criterion employing Eq. (7).

$$K_{[pj-1]} = \left(1 + PD_{[pj-1]}\right) \times K_{[pj]} \quad (7)$$

Where $1 \leq K_{[pj]} \leq 2$ and $K_n = 1$.

Step 5: Determine the subjective weights. The subjective weights of criteria are identified by appliying Eq (8).

$$w_j^s = \frac{K_{[pj]}}{\sum_{pj=1}^{n} K_{[pj]}} \quad (8)$$

3.3. Weight Aggregation Operator

The use of different MCDM procedures in the estimation of the weight coefficients results in slightly different values for the criteria weights. Therefore, following Torkayesh et al. (2021) an aggregation operator is employed to optimally calculate weight coefficients while considering the influence of different MCDM procedures simultaneously. In our study, criteria weights calculated from LOPCOW and SWARA II are respectively represented as w_j^o and w_j^s, and the final weight of each criterion is computed based on Eq. (9).

$$w_j = \frac{w_j^o w_j^s}{\sum_{j=1}^{n} w_j^o w_j^s} \quad (9)$$

3.4. The Calculation Procedure of the Measurement of Alternatives and Ranking According to the Compromise Solution method (MARCOS)

The steps followed in this method to the rank of the non-life insurance companies' performance are as follows (Stević et al., 2020):

Step 1: Forming the initial decision matrix (X). X matrix includes m alternatives ($B = \{B_1, B_2, \dots, B_m\}$) based on the n criteria ($C = \{C_1, C_2, \dots, C_n\}$). This matrix is shown in Eq. (10):

$$\mathrm{X} = \left[\mathrm{x_{ij}}\right]_{\mathrm{m\times n}} \quad (10)$$

Step 2: An extended decision matrix (B) is constructed as shown in Eq. (11):

$$\mathrm{X} = \begin{matrix} \\ B_1 \\ B_2 \\ \vdots \\ B_m \\ AAI \\ AI \end{matrix} \begin{bmatrix} C_1 & C_2 & \cdots & C_n \\ x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ x_{m1} & x_{m2} & \cdots & x_{mn} \\ x_{ai1} & x_{ai2} & \cdots & x_{ain} \\ x_{id1} & x_{id2} & \cdots & x_{idn} \end{bmatrix} i = 1,2, \dots \dots \mathrm{m};\ \ j = 1,2, \dots \mathrm{n} \quad (11)$$

While the anti-ideal solution (AAI) is the worst alternative, the ideal solution (AI) is the best alternative. These values are calculated by applying Eqs. (12) and (13), respectively:

$$AAI = \min\left(x_{ij}\right) \ if\ j \in BC\ and\ AAI = \max\left(x_{ij}\right) \ if\ j \in CC \quad (12)$$

$$AI = \max\left(x_{ij}\right) \ if\ j \in BC\ and\ AI = \min\left(x_{ij}\right) \ if\ j \in CC \quad (13)$$

In Eqs. (12) and (13), while BC represents the benefit-type criteria, CC donates the cost-type criteria.

Step 3: Normalization of the extended initial matrix (X). The elements g_{ij} of the normalized matrix ($G = \left[g_{ij}\right]_{m\times n}$) are determined as follows:

$$g_{ij} = \begin{cases} \dfrac{x_{idj}}{x_{aij}} \ if\ j \in CC \\ \dfrac{x_{aij}}{x_{idj}} \ if\ j \in BC \end{cases} \quad (14)$$

Step 4: Determination of the weighted matrix ($U = \left[u_{ij}\right]_{m\times n}$). In this step, the normalized matrix (Z) is multiplied by the weight coefficients of criterion w_j.

$$u_{ij} = g_{ij} \times w_j \quad (15)$$

Step 5: Computation of the utility degree (Z_i) of alternatives based on the AAI and the AI solutions, respectively.

$$Z_i^- = \frac{S_i}{S_{ai}} \quad (16)$$

$$Z_i^{+} = \frac{S_i}{S_{id}} \tag{17}$$

where:

$$S_i = \sum_{i=1}^{n} u_{ij} \tag{18}$$

Step 6: Calculation of the utility functions $f(Z_i)$ of the alternatives by applying Eq. (19):

$$f(Z_i) = \frac{Z_i^{+} + Z_i^{-}}{1 + \frac{1 - f(Z_i^{+})}{f(Z_i^{+})} + \frac{1 - f(Z_i^{-})}{f(Z_i^{-})}} \tag{19}$$

$$f(Z_i^{-}) = \frac{Z_i^{+}}{Z_i^{+} + Z_i^{-}} \tag{20}$$

$$f(Z_i^{+}) = \frac{Z_i^{-}}{Z_i^{+} + Z_i^{-}} \tag{21}$$

where $f(Z_i^{-})$ represents the utility function regarding the AAI, while $f(Z_i^{+})$ denotes the utility function with respect to the AI.

Step 7: Calculation of the final values of utility functions for the ranking of alternatives. The alternative having the greatest value of the utility function is identified as the best one.

3.5. Correlation Analysis

Correlation analysis is used to obtain information about the strength and direction of the linear relationship between two variables, but it is not used to determine the causality relationship. In statistics, the two most commonly employed correlation coefficients are Pearson and Spearman, respectively. For Pearson correlation, it is assumed that both variables show normal distribution. If this assumption is violated, Spearman correlation, a non-parametric method, can be used instead of Pearson correlation (Kang et al., 2019). Spearman's rank correlation coefficient (r_s) is calculated using Eq. (22):

$$r_s = 1 - \frac{6\sum_{i=1}^{n} d_i^2}{n(n^2 - 1)} \tag{22}$$

3.6. Panel Causality Test

The study next applies the panel causality test proposed by Dumitrescu and Hurlin (2012) (hereafter, DH) to determine the causality relationship between the two variables, i.e., financial performance and premium production. This test considers both cross-sectional dependency and heterogeneity. It is highly flexible and can be applied for balanced and unbalanced panels. Moreover, it can also be implemented for panels with N > T or N < T. The linear panel regression model to test panel causality is given in Eq. (23):

$$FP_{i,t} = \alpha_i + \sum_{k=1}^{K} \gamma_i^{(k)} FP_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)} \ln(PP)_{i,t-k} + \varepsilon_{i,t} \tag{23}$$

In this equation, FP is financial performance; $\ln(PP)$ is the logarithm of premium production; α_i denotes individual fixed effects; K is the number of lag lengths; $\gamma_i^{(k)}$and $\beta_i^{(k)}$ denote autoregressive and slope parameters, respectively. The hypotheses employed for the panel causality test proposed by DH (2012) are as follows:

$H_0: \beta_i = 0, \forall_i = 1,2,\ldots,N$ (there is no causal relationship for all cross-sections in the panel)

$H_1: \begin{Bmatrix} \beta_i = 0, \forall_i = 1,2,\ldots,N_1 \\ \beta_i \neq 0, \forall_i = N_{1+1},\ldots,N \end{Bmatrix}$ (there is a causal relationship for at least one cross-section in the panel)

4. IMPLEMENTATION

This study proposes an integrated model composed of LOPCOW, SWARA II, and MARCOS methods to determine non-life insurance companies' financial performance. Within the proposed integrated model's scope, while LOPCOW and SWARA II are employed to determine the weight coefficients of the criteria, the MARCOS method is utilized to assess non-life insurance companies' performance. Following the determination of financial performance scores of the companies, the link between financial performance and premium production is investigated first by correlation analysis and then by panel causality analysis. In this section, after giving information about the data used for the analysis, we present the empirical results obtained from the analyses performed to determine the association between financial performance and premium production.

4.1. Data Set

As of the end of 2019, although 38 non-life insurance companies operate in the Turkish insurance industry, this sector has been dominated by eight companies. In the period covering 2011-2019, these eight companies ranked in the top 10 in terms of premium production. It should be noted that the data used is limited to 2019 due to the merger of Ziraat and Güneş insurance companies as of August 2020. The companies included in the analysis are Aksigorta (I1), Allianz (I2), Anadolu (I3), Axa (I4), Güneş (I5), Mapfre (I6), Sompo Japan (I7), and Ziraat (I8), respectively.

The data set regarding the premium production and the evaluation criteria included in the financial performance analysis have been obtained from The Republic of Turkey Ministry of Treasury and Finance (2019). The criteria used in the financial performance assessment are Total Assets (C1), Cash and Cash Equivalents (C2), Total Shareholders' Equity (C3), Investment Income (C4), Balance on Technical Account for Non-Life Business (C5), Market Share (C6), Total Debts (C7), Operating

Expenses (C8), respectively. For all criteria, C1; C2; C3; C4 C5; and C6 are the benefit-type, and the remaining are cost-type.

4.2. Results Obtained from The LOPCOW Procedure

The analysis is carried out for the period from 2011 to 2019. Although the study covers a 9-year period, the LOPCOW method's application procedure for 2011 data is given in this subsection. The decision matrix for all years is presented in Table A1 in the Appendix.

Table 3 presents the initial decision matrix consisting of the data used for analysis. By applying Eqs. (2) and (3), the normalized decision matrix (R) is found. This matrix is presented in Table 4.

Table 3. Initial Decision Matrix (2011)

	C1	C2	C3	C4	C5	C6	C7	C8
I1	1203	727	403	58	37	7.85	801	202
I2	1247	135	381	85	62	7.8	866	243
I3	2209	842	705	150	-10	13.3	1504	367
I4	2097	393	509	132	27	13.8	1588	365
I5	865	194	278	27	17	5.66	586	115
I6	991	370	473	60	52	3.85	518	89
I7	445	295	148	25	32	2.28	297	80
I8	197	149	75	11	54	2.2	122	29

Source: The Republic of Turkey Ministry of Treasury and Finance (https://en.hmb.gov.tr/)

Table 4. Normalized Decision Matrix

	C1	C2	C3	C4	C5	C6	C7	C8
I1	0.500	0.837	0.521	0.338	0.653	0.487	0.537	0.488
I2	0.522	0.000	0.486	0.532	1.000	0.483	0.492	0.367
I3	1.000	1.000	1.000	1.000	0.000	0.957	0.057	0.000
I4	0.944	0.365	0.689	0.871	0.514	1.000	0.000	0.006
I5	0.332	0.083	0.322	0.115	0.375	0.298	0.683	0.746
I6	0.395	0.332	0.632	0.353	0.861	0.142	0.730	0.822
I7	0.123	0.226	0.116	0.101	0.583	0.007	0.881	0.849
I8	0.000	0.020	0.000	0.000	0.889	0.000	1.000	1.000
Mean square	0.580	0.500	0.559	0.537	0.680	0.558	0.643	0.645
Standard deviation	0.354	0.374	0.322	0.365	0.323	0.391	0.361	0.385

Then, the PV values and objective weighting coefficients calculated by applying Equations 4 and 5, respectively, are shown in Table 5.

Table 5. PV Values of Criteria and LOPCOW Weighting Coefficients

	C1	C2	C3	C4	C5	C6	C7	C8
PV_j	49.578	29.182	55.111	38.441	74.373	35.561	57.840	51.527
w_j^o	0.127	0.075	0.141	0.098	0.190	0.091	0.148	0.132
Rank	5	8	3	6	1	7	2	4

4.3. Results Obtained from The SWARA II Procedure

After determining the objective weights of the criteria, the subjective criteria weights are obtained by applying the SWARA II procedure. The subjective weights of criteria are identified according to the judgements of an expert committee comprising of practitioners and academics. As indicated in Table 5, the expert committee first sorted the criteria in descending order of importance and then evaluated the preference of each criterion over the next. Consequently, the results obtained by applying Equations (6)-(8) are given in Table 6.

Table 6. Calculations of the Subjective Weights of Criteria

Ranked Criteria	Position p_j	Judgment	$h_{[pj]}$	$PD_{[pj]}$	$K_{[pj-1]}$	w_j^s
C3	1	M	5	0.250	2.776	0.192
C5	2	ML	4	0.160	2.221	0.153
C4	3	VL	2	0.040	1.915	0.132
C8	4	L	3	0.090	1.841	0.127
C6	5	L	3	0.090	1.689	0.117
C1	6	VL	2	0.040	1.550	0.107
C7	7	H	7	0.490	1.490	0.103
C2	8	-	-	-	1	0.069

4.4. Results of Weight Aggregation

After acquiring the objective and subjective weight coefficients employing LOPCOW and SWARA II procedures separately, the two weights are combined based on Eq. (9). The results for 2011 data are reported in Table 7. We also report the calculations of the combined weighting coefficients for other years in Table 8.

Table 7. Integrated Criteria Weights

Ranked Criteria	w_j^o	w_j^s	w_j	Rank
C1	0.127	0.107	0.105	5
C2	0.075	0.069	0.040	8
C3	0.141	0.192	0.209	2
C4	0.098	0.132	0.100	6
C5	0.190	0.153	0.225	1
C6	0.091	0.107	0.075	7
C7	0.148	0.103	0.118	4
C8	0.132	0.127	0.129	3

Table 8. Integrated Criteria Weights for All Years

	2011	2012	2013	2014	2015	2016	2017	2018	2019
	w_j	w_j	w_j	w_j	w_j	w_j	w_j	w_j	w_j
C1	0.105	0.095	0.094	0.112	0.105	0.103	0.102	0.111	0.110
C2	0.040	0.053	0.053	0.067	0.047	0.054	0.042	0.039	0.046
C3	0.209	0.170	0.198	0.204	0.144	0.143	0.130	0.093	0.127
C4	0.100	0.092	0.130	0.102	0.083	0.104	0.106	0.145	0.131
C5	0.225	0.259	0.146	0.074	0.244	0.182	0.260	0.224	0.219
C6	0.075	0.076	0.084	0.110	0.090	0.080	0.073	0.081	0.086
C7	0.118	0.136	0.154	0.148	0.117	0.137	0.093	0.108	0.113
C8	0.129	0.118	0.143	0.182	0.170	0.197	0.195	0.198	0.169

4.5. Results Obtained from The MARCOS Method

In this study, the financial performance of the companies is evaluated by the MARCOS method. Our study covers the 2011-2019 period. Therefore, 2011 data is used in the application of the MARCOS procedure as in the LOPCOW procedure. MARCOS results for data covering other years' data are given in Table 13.

After determining the initial decision-making matrix for the MARCOS method's application procedure, the extended decision matrix including the AI and AAI values for each criterion is created employing Eqs. (12)-(13) and indicted in Table 9. Based on Eq. (14), the extended decision matrix is normalized and is indicated in Table 10.

Table 9. The Extended Decision Matrix

	C1	C2	C3	C4	C5	C6	C7	C8
I1	1203	727	403	58	37	7.85	801	202
I2	1247	135	381	85	62	7.80	866	243
I3	2209	842	705	150	-10	13.30	1504	367
I4	2097	393	509	132	27	13.80	1588	365
I5	865	194	278	27	17	5.66	586	115
I6	991	370	473	60	52	3.85	518	89
I7	445	295	148	25	32	2.28	297	80
I8	197	149	75	11	54	2.20	122	29
AI	2209	842	705	150	62	13.80	122	29
AII	197	135	75	11	-10	2.20	1588	367

Table 10. The Normalized Matrix

	C1	C2	C3	C4	C5	C6	C7	C8
I1	0.545	0.863	0.572	0.387	0.597	0.569	0.152	0.144
I2	0.565	0.160	0.540	0.567	1.000	0.565	0.141	0.119
I3	1.000	1.000	1.000	1.000	-0.161	0.964	0.081	0.079
I4	0.949	0.467	0.722	0.880	0.435	1.000	0.077	0.079
I5	0.392	0.230	0.394	0.180	0.274	0.410	0.208	0.252
I6	0.449	0.439	0.671	0.400	0.839	0.279	0.236	0.326
I7	0.201	0.350	0.210	0.167	0.516	0.165	0.411	0.363
I8	0.089	0.177	0.106	0.073	0.871	0.159	1.000	1.000
AI	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
AII	0.089	0.160	0.106	0.073	-0.161	0.159	0.077	0.079

Then, to find the weighted normalized matrix, the combined weights are multiplied by the normalized matrix. The weighted normalized matrix found using Eq. (15) is shown in Table 11.

Table 11. The Weighted Normalized Matrix

	C1	C2	C3	C4	C5	C6	C7	C8
I1	0.057	0.034	0.119	0.039	0.134	0.043	0.018	0.019
I2	0.059	0.006	0.113	0.057	0.225	0.042	0.017	0.015
I3	0.105	0.040	0.209	0.100	-0.036	0.072	0.010	0.010
I4	0.099	0.019	0.151	0.088	0.098	0.075	0.009	0.010
I5	0.041	0.009	0.082	0.018	0.062	0.031	0.024	0.033
I6	0.047	0.017	0.140	0.040	0.188	0.021	0.028	0.042

I7	0.021	0.014	0.044	0.017	0.116	0.012	0.048	0.047
I8	0.009	0.007	0.022	0.007	0.196	0.012	0.118	0.129
AI	0.105	0.040	0.209	0.100	0.225	0.075	0.118	0.129
AII	0.009	0.006	0.022	0.007	-0.036	0.012	0.009	0.010

In the next step, employing Eqs. (16)-(21), the results of the MARCOS method are obtained and presented in Table 12. The ranking order of the alternatives for 2011 data is as follows: B2>B3>B7>B4>B1>B8>B5>B6.

Table 12. The Results of the MARCOS Method (2011)

	Z_i^-	Z_i^+	$f(Z_i^-)$	$f(Z_i^+)$	$f(Z_i)$	Rank
I1	0.463	11.492	0.039	0.961	0.462	6
I2	0.534	13.267	0.039	0.961	0.533	2
I3	0.509	12.651	0.039	0.961	0.509	4
I4	0.549	13.638	0.039	0.961	0.548	1
I5	0.300	7.451	0.039	0.961	0.300	8
I6	0.524	13.009	0.039	0.961	0.523	3
I7	0.319	7.924	0.039	0.961	0.319	7
I8	0.500	12.426	0.039	0.961	0.500	5

After the financial performance assessment for 2011 data, the weights calculated using fuzzy BWM are transferred to the data sets of other years. The companies' financial performance values for the entire analysis period are found and shown in Table 13.

Table 13. The Results of the MARCOS Method by Years

	2011 $f(Z_i)$	2012 $f(Z_i)$	2013 $f(Z_i)$	2014 $f(Z_i)$	2015 $f(Z_i)$	2016 $f(Z_i)$	2017 $f(Z_i)$	2018 $f(Z_i)$	2019 $f(Z_i)$
I1	0.462	-0.155	0.392	0.332	0.068	0.295	0.356	0.450	0.465
I2	0.533	-0.199	0.429	0.685	0.687	0.675	0.724	0.675	0.726
I3	0.509	-0.083	0.581	0.545	0.499	0.506	0.575	0.679	0.654
I4	0.548	0.507	0.723	0.660	0.050	0.457	0.169	0.586	0.474
I5	0.300	-0.070	0.241	0.301	0.072	0.275	0.294	0.312	0.360
I6	0.523	-0.161	0.378	0.338	0.300	0.350	0.374	0.249	0.269
I7	0.319	-0.098	0.266	0.319	0.273	0.352	0.434	0.491	0.503
I8	0.500	-0.162	0.397	0.419	0.434	0.468	0.484	0.540	0.507

4.6 Sensitivity analysis

The stability and reliability of the results obtained using the MARCOS model were checked by sensitivity analysis. For this goal, the initial rank of alternatives is verified in two stages. In the first stage of the sensitivity analysis, the impact of the change of weight coefficients on initial results from MARCOS is tested. The MARCOS results are then compared to other MCDM procedures (i.e., CRADIS, PSI, and SAW). Since the time period of the study includes 9 years in the period 2011-2019, it should be noted that the year 2011 is determined as a sample for the sensitivity analysis.

4.6.1 Changing the weights of criteria

20 scenarios were prepared in order to evaluate the impact of the most effective criterion on the performance of the rankings obtained. Among the 8 criteria, the most prioritized criterion is C5.

Therefore, the weight coefficient of this criterion was reduced by 1% in each scenario. As for the remaining 7 criteria, the weighting coefficients of these criteria have been proportionally modified to meet the sum of the weights, which should be equal to 1. Table 14 indicates the new weighting coefficients calculated for each scenario. Additionally, Figure 1 shows the new ranking results based on 20 scenarios. From Figure 1, it can be concluded that despite the changes in the ranking positions of some alternatives, criteria weights do not disturb the overall ranking much. In addition, with Spearman's rank correlation coefficient analysis performed to confirm this situation, it was determined that there was at least 0.9268 correlation between the initial rank and the ranks reached through 20 scenarios.

Table 14. Scenarios for sensitivity analysis

	C1	C2	C3	C4	C5	C6	C7	C8
S1	0.1053	0.0403	0.2093	0.1003	0.2228	0.0753	0.1183	0.1293
S2	0.1056	0.0406	0.2096	0.1006	0.2205	0.0756	0.1186	0.1296
S3	0.1060	0.0410	0.2100	0.1010	0.2183	0.0760	0.1190	0.1300
S4	0.1063	0.0413	0.2103	0.1013	0.2161	0.0763	0.1193	0.1303
S5	0.1066	0.0416	0.2106	0.1016	0.2140	0.0766	0.1196	0.1306
S6	0.1069	0.0419	0.2109	0.1019	0.2118	0.0769	0.1199	0.1309
S7	0.1072	0.0422	0.2112	0.1022	0.2097	0.0772	0.1202	0.1312
S8	0.1075	0.0425	0.2115	0.1025	0.2076	0.0775	0.1205	0.1315
S9	0.1078	0.0428	0.2118	0.1028	0.2055	0.0778	0.1208	0.1318
S10	0.1081	0.0431	0.2121	0.1031	0.2035	0.0781	0.1211	0.1321
S11	0.1084	0.0434	0.2124	0.1034	0.2015	0.0784	0.1214	0.1324
S12	0.1087	0.0437	0.2127	0.1037	0.1994	0.0787	0.1217	0.1327
S13	0.1089	0.0439	0.2129	0.1039	0.1974	0.0789	0.1219	0.1329
S14	0.1092	0.0442	0.2132	0.1042	0.1955	0.0792	0.1222	0.1332
S15	0.1095	0.0445	0.2135	0.1045	0.1935	0.0795	0.1225	0.1335
S16	0.1098	0.0448	0.2138	0.1048	0.1916	0.0798	0.1228	0.1338
S17	0.1100	0.0450	0.2140	0.1050	0.1897	0.0800	0.1230	0.1340
S18	0.1103	0.0453	0.2143	0.1053	0.1878	0.0803	0.1233	0.1343
S19	0.1106	0.0456	0.2146	0.1056	0.1859	0.0806	0.1236	0.1346
S20	0.1109	0.0459	0.2149	0.1059	0.1840	0.0809	0.1239	0.1349

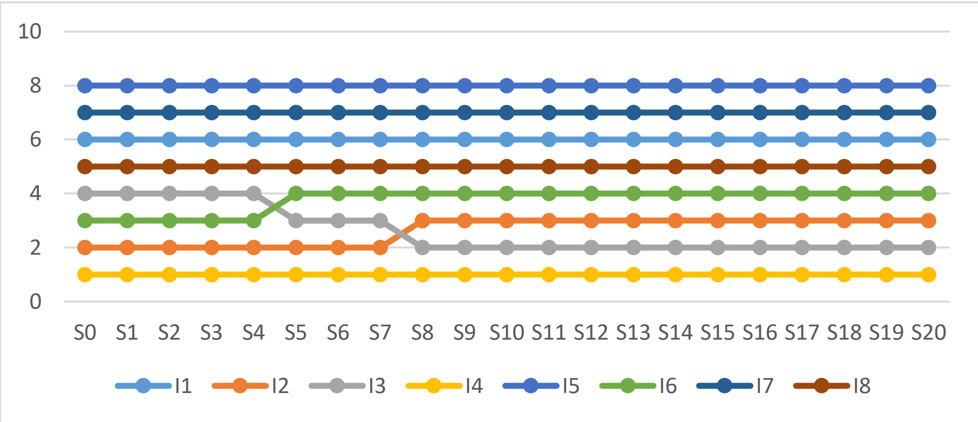
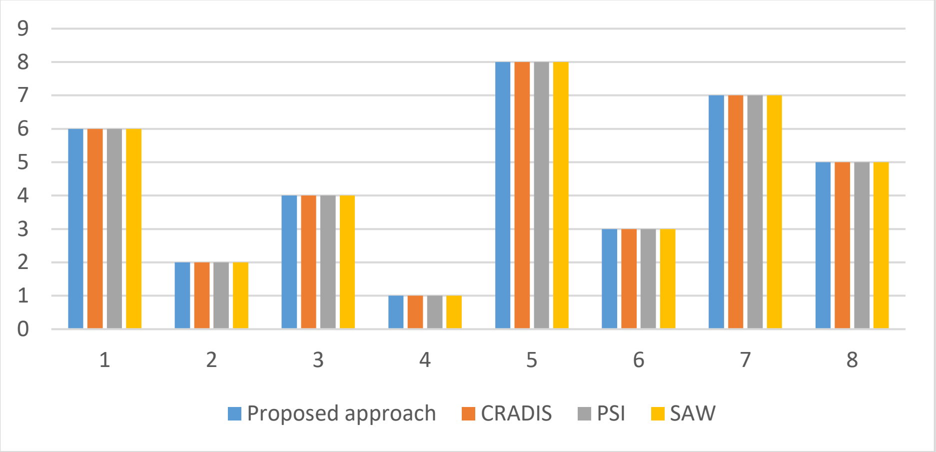


Figure 1. Result of sensitivity analysis.

4.6.2 Comparison with other MCDM procedures

In the second stage of the sensitivity analysis, MORCOS results were compared with those of some MCDM approaches such as CRADIS (Puška et al., 2022), PSI (Maniya and Bhatt, 2010), and SAW (MacCrimmon, 1968). According to the results presented in Figure 2, no change was observed in the ranking position of the alternatives. Consequently, the comparison results shown in Figure 2 confirm the robustness of the introduced approach and its findings.



4.7 Results of The Correlation Analysis

In statistical analysis, the correlation analysis method is determined based on whether both variables show normal distribution. This study determined whether the variables showed normal distribution by using the Shapiro-Wilk W test (Shapiro and Wilk, 1965). The result of the normal distribution test for each variable is indicated in Table 15. The values of both series do not have a normal distribution because the null hypothesis of normality is rejected for each series. Therefore, it was decided that the method to be employed in correlation analysis was Spearman's rank correlation coefficient.

Table 15. Result of Shapiro-Wilk W Test for Normal Data

	Obs.	W-statistic	p_value
FP	72	0.92279[a]	0.00029
Ln(PP)	72	0.96908[c]	0.07332

Note: [a] and [c] denote the rejection of the null hypothesis of normality at the 1% and 10% significance levels.

The Spearman rank-order correlation coefficient employed in our study does not give information regarding the causality of the variables. It only measures the strength and direction of the relation between two variables. As can be seen in Table 16, it is determined that there is a positive and significant association between financial performance and premium production at a 1% level. Thus, we could say that our variables move in the same direction.

Table 16. Result of Spearman's Rank Correlation Analysis

		FP	Ln(PP)
FP	Correlation coefficient	1.0000	0.5501[a]
	p_value (2-tailed)	-	0.0355
	Obs.	72	72
Ln(PP)	Correlation coefficient	0.5501[a]	1.0000
	p_value (2-tailed)	0.0355	-
	Obs.	72	72

Note: [a] denotes the rejection of the null hypothesis of no correlation at the 5% significance levels.

4.8 Results of The DH Panel Causality Analysis

In the next stage, the causality direction between the variables is investigated employing a panel causality test proposed by DH (2012). This test requires the analyzed series to be stationary at the same level (i.e., $I(0)$ or $I(1)$). Although there are many unit root tests developed to test the stationary of the series in the literature, we employ the IPS test (Im *et al.*, 2003). This is because this test takes the heterogeneity into account between the different cross-section units and overcome serially correlated errors. The results for the IPS test are reported in Table 17. As indicated in Table 17, the null hypothesis of nonstationarity is rejected for both series. For robustness, we employ the LLC test (Levin *et al.*, 2002). The LLC test results support those of the IPS, which means both series are stationary at levels. In other words, these series do not contain a unit root.

Table 17. Results of IPS and LLC unit root tests

		IPS		LLC	
		Statistic	p-value	Statistic	p-value
FP	Constant	-1.7694[b]	0.0384	-4.8393[a]	0.0000
	Constant and trend	-2.9244[a]	0.0017	-3.2248[a]	0.0006
ln(PP)	Constant	-2.2641[b]	0.0118	-1.3659[c]	0.0860
	Constant and trend	-3.3432[a]	0.0004	-3.5900[a]	0.0002

Note: Both tests include a panel mean. The optimal lag length is selected using the AIC. [a] and [b] denote the rejection of the null hypothesis of nonstationarity at the 1% and 5% significance levels, respectively.

Following the stationary analysis, the direction of the relationship between financial performance and premium production is estimated by the DH (2012) panel causality analysis. The combined panel causality results illustrated in Table 18 show a bidirectional causality between financial performance and premium production. That means the variations in financial performance lead to the changes in premium production and vice versa.

Table 18. Results for DH (2012) Panel Causality Tests

	$\bar{Z}$**-Statistic**	**p-value**	$\tilde{Z}$ **−Statistic**	**p-value**	**Decision**
ln(PP) → FP	15.8499[a]	0.0000	4.3550[a]	0.0000	Reject
FP → ln(PP)	7.7973[a]	0.0000	1.9392[c]	0.0525	Reject

Note: "→" means the direction of the causality relationship. [a] and [c] denote the rejection of the null hypothesis of no causality at the 1% and 10% significance levels, respectively. The test was performed with one lag.

Table 19 reports the individual panel causality results for insurance companies. The findings reveal that there is positive causality from premium production to financial performance in all insurance companies (Aksigorta, Allianz, Anadolu, Güneş, Mapfre, Sompo Japan, and Ziraat), except for Axa, and support that financial performance will increase with the increase in premium production. However, our results suggest that a bidirectional causal nexus exists between premium production and financial performance for Allianz and Anadolu. The result of the DH (2012) heterogeneous panel causality also suggests evidence of unidirectional causality from financial performance to premium production for Axa.

Table 19. Results of Individual DH (2012) Causality Tests

	ln(PP) → FP		**FP → ln(PP)**	
	W_i	**p-value**	**W_i**	**p-value**
Aksigorta	3.936	0.047[b]	0.172	0.678
Allianz	9.023	0.003[a]	20.010	0.000[a]
Anadolu	11.743	0.001[a]	14.023	0.000[a]
Axa	0.412	0.521	2.771	0.096[c]
Güneş	6.020	0.014[b]	0.436	0.509
Mapfre	7.128	0.008[a]	0.591	0.442
Sompo Japan	28.153	0.000[a]	0.436	0.509
Ziraat	4.850	0.028[b]	0.109	0.741

Note: "→" means the direction of the causality relationship. [a, b] and [c] denote the rejection of the null hypothesis of no causality at the 1%, 5%, and 10% significance levels, respectively. The test was performed with one lag.

5. DISCUSSION AND MANAGRIAL IMPLEMENTS

Micro and macro functions of both life and non-life insurers operating in the insurance market are of great importance for sustainable development. The insurance sector in Turkey is growing and developing every year. Accordingly, the share of premium production in gross domestic product tends to increase in general.

Premium production, which is a critical determinant of financial performance, reflects the competitiveness and efficiency of companies in the insurance market. On the other hand, financial performance is a key indicator that reveals whether insurers have achieved their predetermined goals and objectives.

The nexus between these two variables is critical both for the management staff and for the regulatory and supervisory authorities. Theoretically, an increase in premium production can be expected to increase financial performance, but vice versa. That is, increased financial performance can mobilize firm management and motivate them to generate more premiums. Therefore, there may be an endogenous linkage between financial performance and premium production due to reverse causality.

Determining the link between financial performance and premium production provides tactical and strategic information to the top management of insurers and insurance intermediaries such as insurance agents, bank branches and brokers in order to improve the quality of service offered and to develop new products for customers' needs. It also makes it easier for the regulatory authorities to assess the current situation of the industry and make long-term decisions about the future of the industry.

Our results can be beneficial to regulatory authorities and policy-makers in establishing stability and ensuring sustainable economic growth. Given that Turkey's insurance market has a dynamic structure, our results are also important for foreign investors who want to invest in this sector. Finally, the results of the study can help managers in the industry make more sound decisions with more accurate and reliable information, which makes it easier for all interest groups related to the company to make appropriate economic decisions.

6. CONCLUSION

The recent dynamics such as financial crises, natural disasters, wars, and epidemics have led to a change in individuals' and institutions' perspectives on the insurance sector, which has increased the interest in services offered by the insurance industry. Due to insurance companies' important contributions to social and economic life, measuring and assessing insurance companies' financial performance has gained importance in the literature.

The purpose of this study is to measure the financial performance of insurance companies and to examine empirically the relationship between the measured financial performance and premium production, which is one of the most striking indicators in the insurance industry. In order to achieve this goal, the financial performance of the companies is determined with a novel integrated MCDM model consisting of the LOPCOW, SWARA II and MARCOS techniques. Following the determination of financial performance with the proposed model, correlation analysis was conducted to test whether there is a linear relationship between premium production and financial performance. The result of the Spearman rank correlation coefficient reveals that there is a strong positive relationship between financial performance and premium production. However, Spearman correlation analysis does not provide information about the direction of causality between variables. Therefore, we use Dumitrescu-Hurlin's causality approach to determine the relationship between the two variables under investigation. The results from the Dumitrescu-Hurlin causality tests demonstrate that two-way causal relationships exist between financial performance and premium production. However, considering the individual causality results for companies, it can be deduced that two-way causality is valid only for Allianz and Anadolu insurance companies.

It should be underlined that this study is a pioneering study compared to previous studies in the literature, since both multi-criteria decision-making approaches and panel data econometrics are used together in the analysis of the causality relationship between multi-dimensional financial performance and premium production. The data period can be considered as the first limitation of the study. Another limitation is that the findings are valid only for the companies that are the subject of the analysis. These findings are not generalizable to other companies in the same industry. In future studies, the subject of research can also be examined in terms of life and pension companies. However, the relationship between multi-dimensional firm performance and economic growth can also be investigated using the steps followed in this study. Furthermore, the model (LOPCOW-SWARA-II-MARCOS) may be extended and tested by employing rough, fuzzy, and gray set-based models in future studies.

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APPENDIX

Table A1. Decision Matrix (2011-2019).

		C1	C2	C3	C4	C5	C6	C7	C8
2011	I1	1203	727	403	58	37	7.85	801	202
	I2	1247	135	381	85	62	7.80	866	243
	I3	2209	842	705	150	-10	13.30	1504	367
	I4	2097	393	509	132	27	13.80	1588	365
	I5	865	194	278	27	17	5.66	586	115
	I6	991	370	473	60	52	3.85	518	89
	I7	445	295	148	25	32	2.28	297	80
	I8	197	149	75	11	54	2.20	122	29
2012	I1	1248	735	424	70	55	7.66	825	249
	I2	1733	351	494	88	84	13.06	1239	281
	I3	2498	969	756	154	-72	8.44	1742	446
	I4	2474	739	13	122	-600	13.94	2461	441
	I5	993	210	308	35	-3	5.39	685	137
	I6	1162	532	493	56	61	5.18	670	130
	I7	545	347	177	30	31	2.63	369	93
	I8	236	148	95	17	58	2.21	141	31
2013	I1	1553	895	533	98	101	7.32	1020	291
	I2	2221	555	542	129	146	9.32	1679	388
	I3	3253	1154	913	186	101	13.20	2340	463
	I4	4019	1366	922	209	293	15.21	3097	517
	I5	1213	262	335	56	-31	5.17	878	153
	I6	1547	524	536	149	24	6.49	1012	199
	I7	682	447	212	32	39	2.67	470	114
	I8	360	222	121	18	67	2.72	239	45
2014	I1	1658	820	508	128	42	7.55	1150	330
	I2	4321	1472	1336	398	365	14.16	2984	660
	I3	3773	1606	1020	259	121	13.23	2754	523
	I4	4667	1369	1312	327	350	13.55	3354	587
	I5	1361	357	387	64	32	5.34	974	169
	I6	1760	574	582	82	73	6.57	1179	238
	I7	848	551	251	46	35	3.02	597	120
	I8	469	308	151	32	74	3.10	318	79
2015	I1	1898	551	349	233	-149	5.95	1549	340
	I2	5531	1372	1401	707	245	14.86	4130	737
	I3	4888	2305	1202	368	104	13.24	3686	605
	I4	4888	983	919	432	-311	11.24	3969	621
	I5	1537	501	306	100	-143	4.73	1231	214
	I6	2333	1036	587	124	49	7.74	1747	275

	I7	1225	849	278	69	33	3.90	947	140
	I8	594	426	196	56	105	3.42	398	87
2016	I1	2079	481	403	185	120	5.35	1676	324
	I2	7382	2140	1642	550	416	16.29	5739	997
	I3	5974	3217	1223	488	158	12.65	4751	743
	I4	5598	1090	960	500	209	10.05	4638	696
	I5	1756	665	433	83	18	3.87	1323	206
	I6	3133	1570	685	187	149	7.88	2448	398
	I7	2423	1952	420	134	170	6.31	2003	256
	I8	838	615	265	61	148	3.77	573	108
2017	I1	2781	1352	629	282	214	6.64	2152	364
	I2	7653	2598	2267	757	594	12.93	5386	1079
	I3	7032	3505	1639	860	293	11.76	5393	756
	I4	6011	1078	1009	668	-359	7.32	5002	667
	I5	2168	865	678	173	28	4.18	1490	224
	I6	3395	1416	894	274	232	6.75	2501	419
	I7	3259	2736	848	275	302	5.70	2411	305
	I8	1150	849	435	94	252	4.37	716	132
2018	I1	3538	1970	718	641	368	7.16	2820	448
	I2	8686	3023	2487	1290	481	12.17	6199	1029
	I3	7904	4074	1646	1509	502	11.94	6258	835
	I4	6680	1165	1082	1283	532	7.07	5598	653
	I5	2610	1072	802	362	26	4.00	1808	255
	I6	3581	1090	682	450	-42	5.54	2898	397
	I7	3922	3058	1136	1047	267	5.26	2787	316
	I8	1588	1186	644	208	320	4.60	944	146
2019	I1	4640	2063	899	647	584	7.73	3742	554
	I2	10680	3308	3233	1265	803	11.96	7447	1117
	I3	9767	4636	2155	1373	643	11.41	7612	1003
	I4	8129	1254	1775	925	433	7.09	6354	795
	I5	3663	1689	1290	344	153	3.91	2373	318
	I6	3805	1569	743	429	16	4.83	3062	489
	I7	5182	3544	1617	995	412	5.81	3565	428
	I8	1985	1439	742	255	422	4.81	1243	191

Note: The C6 criterion is in %, while the other criteria are in TL (million).

Table A2. Premium Production by Years

	2011	2012	2013	2014	2015	2016	2017	2018	2019
I1	1137	1311	1526	1714	1622	5775	2636	3417	4474
I2	1129	2235	1942	3216	4051	4484	5134	5810	6923
I3	1926	1445	2750	3005	3611	3562	4671	5701	6607
I4	1998	2386	3168	3078	3066	1373	2908	3375	4104
I5	820	922	1077	1213	1288	2795	1661	1907	2266
I6	558	887	1353	1491	2111	2236	2680	2645	2797
I7	330	451	556	687	1063	1338	2263	2509	3363
I8	318	379	568	703	932	5775	1736	2197	2782

Note: Premium production is in TL (million).